

Lessons Learned from DTL Tank 1 Commissioning

The following comments and requests are made to enhance the operability and efficiency of systems in general as well as beam operation for data taking. This compilation of comments is based on the running experience gained during DTL Tank 1 commissioning.

Front End Systems Comments:

1. RFQ

- 1.1. Chillers – In order to prevent problems with the chillers which may have played a role in the frequency shift of the RFQ:

- Implement software limits for chiller temperature
- Implement hardware limits for chiller temperature
- Fix RFQ Chiller 2. It keeps tripping off with no displayable reason?

- 1.1. Further investigation of the “frequency shift event”

- Measure and document field distribution of several major RFQ modes (dipole, etc.) in order to have reference if frequency shift happens again
- Perform independent mechanical analysis of the RFQ structure.
- Measure resonant frequency periodically (once a month) between commissioning periods.

- 1.2. HPRF power distribution network (long term)

- Order additional spare RF windows and/or fix the leaking one
- Set up stand for conditioning of the spare RF windows and organize in vacuum storage after conditioning.
- Modify design of the distribution network to provide decoupling between power loops or come up with some other reliable tuning mechanism

- 1.3 LLRF Discover why did the apparent phase of the RFQ jumped by 90 degrees from time to time?

- Restart of the RFQ is hard. The best way is at high power by changing the frequency manually. This is too person-intensive and needs to be automated.

- 1.3. Controls

- Provide closed loop Resonant Control System (software)
- Set up separate archiver for the RFQ parameters with ~1min interval

- 1.5 Mechanical

- Resolve water flow meter problem.

2. MEBT

- Rebuncher RF power amplifiers

- Provide nominal power for rebunchers #1,4

- Improve reliability for all amplifiers

- Investigate tuner failures

- Discover why the feedback parameters seem to change from day to day and fix it.

RF trips on VSWR but this shows up as “Cabinet Temp” on display leading to mis-diagnosis of the problem

Diagnostics

Replace BPMs #1, 14 with new ones

Fix WS#14

Provide fast channel from BCM for chopped beam measurements

Power supplies

Incorporate measured PS calibration in magnet strength calculation

Choppers

Fix LEBT chopper channel B

Synchronize chopper pattern generator with timing system

Create chopper control screen for operators

MPS

Create new MPS mode to allow stand alone Front End operation to the MEBT beam stop.

Operations Comments:

Controls

Resolve the “IOC Disease”

Cure the “Bumpy Reboot” problem

Resolve the “Sequencer Disease”

Alarm Handler

Improvement of operability needed

*.wav files needed for the alarm handler (or voice generating device)

PVs need to be at approved values with appropriate deadband and limit values for alarm handler

Archiver

Re establish the Global Archiver

The PVs need to be at approved values with appropriate deadband and limit values for archiver

All PV's in use must be in the archive.

The archive files should be periodically checked for problems.

- I. We need some kind of audible indication when the beam has disappeared. It is rather difficult to constantly stare at the beam trace especially if one is engaged in something else.

A significant amount of down time was accrued to the wrong category because of ambiguities in the description in the MPS sub-pages. i.e. A spark/trip in the RFQ that was induced by high reflected power which in turn was due to water temperature fluctuation... that trip the may have been logged to vacuum because of the description in the MPS sub-pages. We need a “First Out” indication.

PV Access

Need greater access granted to all Chief Operators for ALL PV controls

All privileges must be stripped from the vactech and other expert accounts except their own system related items

Startup Scripts

Need ramp-up scripts for RF power

Operations

Operational discipline will be used. The beam will ONLY be on for making measurements.

Put MPS in "STANDBY" during RF processing to eliminate unnecessary trips .

Diagnostics

The differential BCM system needs to be upgraded. It was too susceptible to noise.

Mis-calibration of Beam Stop BCM led to unnoticed beam losses in BSM and higher than expected prompt and residual radiation.

RCCS

The DTL RCCS needs work:

We should not start operation with any flow interlocks in Yellow range

We should not start operation with the pump running at over 90% flow

The RCCS systems should be "pumped up" weekly. A pressure gauge is needed at the fill station.

Improvement in Valves

- a. new 2-way valve hardware with faster response
- b. new PLC logic to link the 3-way to the 2-way valve operation together (an idea was that the pressure, temperature, and flow could all be used as inputs).
- c. Auto-frequency needs an option to be automatically engaged when it sees RF for 5 seconds as well as switching to Auto-Temp mode when the RF is off.
- d. Auto-Temperature mode needs to have a one temp to climb to instead of trying to stay in the same range it was in when the RF tripped off (there's a 4-5 deg C difference between the operating range and the startup range).

Power Supplies

ME

ME's need some time of indication that the filaments are warming up before the actual 12 minute countdown starts. It leaves you wondering if it is going to go into a warm-up or if there is another unseen problem.

PPS

There needs to be an audible chirper installed on the PPS panel that sounds in conjunction with a Chipmunk alarming/warning.

The magenta beacon warning level at 5 mR/hr should also have an audible local alarm.

A beacon/alarm should be added in the mezzanine

The beacons in the to the East and West of the DTL enclosure, and in the Mezzanine should indicate separately so as not to give false alarms to the wrong area.

Accelerator Physics Comments:

Modifications to the Online Model which will save us time and effort include:

- Call compare to a saved orbit
- Plot beam size
- Solver interface for fitting
- Add phase slip to the probe
- Add T-3D algorithm
- Add dispersion
- Add closed orbit, + chromaticity
- Overlay saved beam profiles to the online model output
- Add external lattice generation

DTL Acceptance scan

- Run the beam as “Beam on Demand” ONLY

Beam Profiles

We need a general profile runner, that saves raw data and fits for a range of variables

Diagnostics:

- 1) Need save-set of user adjustable diagnostics settings
- 2) Need users guide to each diagnostic device.
- 3) Each screen should have a help button.
- 4) Improve reliability of BPM system. Frequent crashes.
- 5) We should be more thoroughly trained on diagnosing diagnostics.
- 6) Labeling of graphs
- 7) Timestamp issue for correlating PVs
- 8) Need ability to observe beam over 1 second (measure rep-rate, etc.)

Tuning Knobs:

- 1) Need “group” adjustment of LEBT steerers (A&B, C&D differential and common-mode)
- 2) Need “group” adjustment of MEBT RF phase.

Controls:

- 1) IOC & Server synchronization issue for correlated data. Need to be able to capture/analyze waveforms when beam is there.
- 2) Archiver: need valid times tamps.
- 3) Need Tuning screens as opposed to Expert Screens
- 4) Need set of analog and scope signals for diagnosing timing system issues, looking at diagnostic gates etc.
- 5) “Bumpless” Reboot is very bumpy. Need to ensure proper restoration after a reboot.
- 6) Need annunciator tied to some global fault screen: “The MPS has tripped because LEBT valve is closed.” “A MEBT Quadrupole Supply has tripped.”

MPS:

- 1) MPS shutoff of HVCM is too disruptive. There must be a better way. [Done]
- 2) MPS system should tell the operator what tripped.
- 3) Having done so, there should be a single button reset when simple reset is required.
- 4) Need MPS trip (first fault) logging to collect statistics

RF:

- 1) Need single button “RF-ON” that goes through a startup procedure after a trip
- 2) Need rebuncher beam-loading signals in the Control Room for checking phase

Organization/Control Room:

- 1) Tailor skills of operators to to-do list Operations should own some scopes and maintain a stash of cables & connectors

- 2) IOC Reboot policy
- 3) We should start writing Operator Tuning Procedures (e.g. MEBT RF phase setting, DTL phase setting, etc.)